UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/596,137	09/19/2006	Jun Tanida	09656/0204589-US0	2698

7278 7590 07/20/2009

DARBY & DARBY P.C.
P.O. BOX 770
Church Street Station
New York, NY 10008-0770

EXAMINER	
PATEL, NIRAV G	
ART UNIT	PAPER NUMBER
2624	
MAIL DATE	DELIVERY MODE
07/20/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/596,137	TANIDA ET AL.	
	Examiner	Art Unit	
	Nirav G. Patel	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 April 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

It would be of great assistance to the Office if all incoming papers pertaining to a filed application carried the following items:

1. Application number (checked for accuracy, including series code and serial no.).
2. Group art unit number (copied from most recent Office communication).
3. Filing date.
4. Name of the examiner who prepared the most recent Office action.
5. Title of invention.
6. Confirmation number (See MPEP § 503).

Response to Arguments

1. Applicant's arguments filed 4/21/2009 have been fully considered but they are not persuasive.

Applicant's argument for Claim 1:

-Tanida's image reconfiguring by means of arithmetic average method cannot obtain a high resolution image.

Examiner's Response - The claim language does not claim obtaining a high resolution image.

-Tanida's pseudo inverse method has other difficulties in real world applications.

Examiner's Response - The claim language does not recite limitations relating to real world applications.

-Tanida's method does not obtain the same level of high resolution image data.

Examiner's Response - The claim language does not recite limitations relating to resolution levels.

-Tanida cannot achieve setting as claimed in the amended claim 1, regarding initial value and iterative control means.
Examiner's Response - The claim language does not recite limitations relating to the setting and resolution levels.

-Tanida does not generate the initial image of single object image under the preset condition of the amended claim.
Examiner's Response - Please see analysis of amended claim.

-Regarding the comments on page 9 of response, examiner is unclear of the response in lines 1-3.

-Tanida has a fundamental limitation to obtain a high resolution image
Examiner's Response - The claim language does not recite limitations regarding obtaining a high resolution image.

-Tanida's image update means is a linear arithmetic average method and not an inverse process, or back projecting.

Examiner's Response - Tanida does update the image using back projecting (Page 35, Lines 18-20).

Applicant's argument for Claims 2-4 – the claims depend on claim 1 and by dependency, should be allowed.

Examiner's Response – The rejection is maintained and therefore the grounds of rejection for Claims 2-4 stand.

Applicant's argument for Claim 5 – the claim recites similar elements and the arguments for claim 1 apply.

Examiner's response – See responses for claim 1.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1 through 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tanida et al. ("Compact image capturing system based on compound imaging and digital reconstruction," "Tanida") in view of Tanida et al. ("Thin observation module by bound optics (TOMBO): an optoelectronic image capturing system," "Tanida 2000").

1) Regarding Claim 1, Tanida teaches image configuring apparatus comprising an object image configuring means, which reads image data of a plurality of reduced object images from a reduced image recording means for recording image data of a plurality of reduced object images obtained by photographing an object as using a compound-eye camera that focuses a plurality of reduced object images on a photo detector through micro lens array having a plurality of micro lenses arrayed therein, and configures a single object image based on said image data and then outputs its image data (Page 34 Lines 1-2: A compact image capturing system called TOMBO is used which acquires a plurality of images through a micro lenses array, which then outputs a single image),

wherein said object image configuring apparatus is also configured that preset in the conditions including the distance between object and micro lens array (Figure 8: The distance between the micro lens array and object (input image) is set between 90-120mm), using the aligning distance of each micro lens of lens array and the focal length of micro lens array (Figure 8: The distance between the lens and the object is known. Page 36, Lines 6-8: The focal length of the micro lens array is 650 μm), and based o n such presetting condition, the magnification ratio of reducing optical system is calculated with the known distance to the object (Figure 8: Using the distance to the object, and the focal length, the magnification ratio is calculated ($M = f/f\text{-}d_o$, where f is the focal length and d_o is the distance to the object (90-120mm))), and by obtaining the relation among one pixel of the reduced image element and its corresponding area of the object (Page 38, Lines 16-17: The pixels of the acquired images of the object is mapped onto a virtual plane),

an iterative control means for firstly giving said initial image data to said reduced image estimating means as an initial value of an image data of said single object image, and then repetitively conducting an estimating processing of said reduced image estimating means as well as an updating processing of said object image updating means until said difference satisfying a predetermined condition, then outputting an image data of said single object image at the time of said difference satisfying said predetermined condition as a final image data of an object image (Page 39 Lines 17-18: an iterative algorithm is utilized which uses an evaluation function (predetermined condition) to update the image data of the single object image and produces (outputting) the image data of the single object image as final image data, as illustrated in Figure 10).

Tanida fails to teach wherein said object image configuring apparatus is also configured that said micro lens and said light receiving elements are set without alignment error; previously obtain the geometric transfer function T_k describing optical projection from the said real object to create said reduced image element and inverse transfer function T_k^{-1}, wherein said object image configuring means comprising:

a generating means of initial object image for generating an initial image data of a single object image based on an image data of a plurality of said reduced object images captured by said micro lens array under said known condition using said inverse transfer function T_k^{-1}; a reduced image estimating means for estimating an estimated image of each of said reduced object images from an image data of a provided single object image which comes from said generating means of initial object image, based on a geometric projection process where said transfer function T_k is used; an object image updating means for updating an image data of said single object image provided in said

reduced image estimating means by projecting a difference between said estimated image of each reduced object images which comes from said reduced image estimating means and each of said reduced object images which is captured under said known condition of micro lens array, using said inverse process T_k^{-1} of said geometric projection process.

However, in the same field of endeavor, Tanida 2000 teaches wherein said object image configuring apparatus is also configured that said micro lens and said light receiving elements are set without alignment error (Pages 1031 & 1032, Lines 28 & 1: For the precise adjustment of the components (without error), a special holder is fabricated), and

previously obtain the geometric transfer function T_k describing optical projection from the said real object to create said reduced image element and inverse transfer function T_k^{-1},(Page 1033, Lines 18-22: a relation is described between the element on the object and the photo-sensitive cells (image element), assigned to the transfer matrix (function) H. A pseudoinverse matrix H^+ is calculated (Lines 28-30) (inverse transfer function))

wherein said object image configuring means comprising: a generating means of initial object image for generating an initial image data of a single object image based on an image data of a plurality of said reduced object images captured by said micro lens array under said known condition using said inverse transfer function T_k^{-1} (Page 1034, Lines 14-17: The back projection method is applied to the signals captured by the TOMBO system using the matrices H and H^+ (inverse transfer function));

a reduced image estimating means for estimating an estimated image of each of said reduced object images from an image data of a provided single object image which comes from said generating means of initial object image, based on a geometric

projection process where said transfer function T_k is used (Page 1033, Lines 18-25: The system matrix H (transfer function) is used to estimate each of the images captured by the photo-sensitive cells);

an object image updating means for updating an image data of said single object image provided in said reduced image estimating means by projecting a difference between said estimated image of each reduced object images which comes from said reduced image estimating means and each of said reduced object images which is captured under said known condition of micro lens array, using said inverse process T_k^{-1} of said geometric projection process (Page 1034, Lines 8-13: The back projection method retrieves an updated image using an inverse process).

Applying the teachings of Tanida 2000 to Tanida's apparatus allows for using a transfer function and an inverse transfer function which allows for using back projection methods to reconstruct an image acquired by a micro lens array yielding a high-resolution image, and therefore a better result due to the increase in quality of the image.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply the teachings of Tanida 2000 to Tanida.

2) Regarding Claim 2, Tanida teaches in combination with Tanida 2000 the limitations of claim 1, and further teaches object image configuring means further comprises a shift amount calculating means for calculating a shift amount in regard to a gap of relative positions between said reduced object images through correlation calculation between said reduced object images by using an image data of a plurality of

said reduced object images (Page 39 Lines 2-3: each unit image (reduced images) is correlated with a reference image to determine the lateral offset (shift amount)).

3) Regarding Claim 3, Tanida teaches in combination with Tanida 2000 the limitations of claim 1, and further teaches object image configuring means further comprises a projection process deriving means for obtaining a conversion equation indicating said geometric projection process employed in said reduced image estimating means based on said shift amount obtained in said shift amount calculating means (Page 39 Lines 4-6: R(x, y) is a conversion equation, which is normalized correlation using f(x, y) and g(x, y) of the reference and unit images and the shift calculated of the shift amount calculating means).

4) Regarding Claim 4, Tanida teaches in combination with Tanida 2000 the limitations of claim 1, and further teaches generating means of initial object image in said object image configuring means generates an image data of a single object image by arranging a plurality of said reduced object images onto a same area based on said shift amount obtained in said shift amount calculating means, and then generates an initial image data of said single object image by interpolating blank pixels with respect to said image data (Page 39 Lines 9-10: The offset values (shift amount) of the unit images are calculated using the calculating means. These pixels are then mapped on the virtual image plane to generate image data of a single object image. Page 38 Lines 9-10: Interpolation is used to compensate information of the pixels which are not assigned the pixels of the unit images (blank pixels) generating an initial image data).

5) Regarding Claim 5, Tanida teaches image configuring method for configuring a single object image based on an image data of a plurality of reduced object images obtained by photographing an object as using a compound-eye camera that focuses a

plurality of reduced object images on a photo detector through micro lens array having a plurality of micro lenses arrayed therein (Page 34 Lines 4-5:A new algorithm for image reconstruction has been developed using a TOMBO system is used which generates a plurality of reduced object images on a micro lens array (Figure 1)), comprising the steps of:

estimating an estimated image of each of said reduced object images from an image data of a provided single object image based on a geometric projection process using a transfer function T_k (Page 38 Lines 5-6: A pixel rearrange method is used where pixels in the unit images are rearranged onto a virtual image plane, which is a parallel projection, a form of a geometric projection process. See Figure 7 for illustration.);

updating an image data of said single object image provided in said reduced image estimating process by projecting a difference between estimated images of each of said reduced object images and each of said reduced object images in an inverse process (T_k^{-1}) of said geometric projection process (Page 39 Lines 13-14: Linear interpolation between valid pixels (image data) is done to update the image data. Figure 9(c) shows the geometric process and 9(d) shows the updated image which uses interpolation (inverse of geometric process));

providing said initial image data to said reduced image estimating process as an initial value of an image data of said single object image; repetitively conducting said reduced image estimating process as well as said object image updating process until said difference satisfying a predetermined condition; and outputting an image data of said single object image at the time of said difference satisfying said predetermined condition as a final image data of an object image (Page 39 Lines 17-18: an iterative algorithm is utilized which uses an evaluation function (predetermined condition) to update the image data of the

single object image and produces (outputting) the image data of the single object image as final image data, as illustrated in Figure 10).

Tanida fails to teach generating an initial image data of a single object image based on an image data of a plurality of said reduced object images using known conditions and an inverse transfer function T_k^{-1}.

Tanida 2000 teaches generating an initial image data of a single object image based on an image data of a plurality of said reduced object images using known conditions and an inverse transfer function T_k^{-1} (Page 1034, Lines 14-17: The back projection method is applied to the signals captured by the TOMBO system using the matrices H and H^+ (inverse transfer function)).

Generating an image using an inverse transfer function allows for using back projection methods to reconstruct an image acquired by a micro lens array yielding a high-resolution image, and therefore a better result due to the increase in quality of the image.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply the teachings of Tanida 2000 to Tanida.

Conclusion

4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nirav G. Patel whose telephone number is (571)270-5812. The examiner can normally be reached on Monday - Friday 8 am - 5 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on 571-272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nirav G. Patel/
Examiner, Art Unit 2624

/Wenpeng Chen/
Primary Examiner, Art Unit 2624
7/17/2009